Wintec® Energy, LTD.

Friday, December 29, 2000

VIA HAND DELIVERY

Mr. Weston L. Williams, Manager
Grid Contracts/Tariff Negotiations/Development
Southern California Edison Company
2244 Walnut Grove, G01, Room 460
P. O. Box 800
Rosemead, CA 91770

RE: Wintec Energy, Ltd. TO Tariff Service Request VIII

Dear Mr. Williams:

Please find enclosed our referenced TO Tariff Service Request as summarized below:

1. 45MW Application Request – WINTEC REQUEST VIII;
2. USGS Map of the Vicinity;
3. Aerial Photograph of the area;
4. Copy of the Grant Deed proving site control;
5. Generation Data Sheet and unit sizing table
6. Transformer Data Sheets
7. One Line Drawings of the Facility and Interconnect

In addition, we request that Southern California Edison Company initiate the expedited procedures pursuant to Section 10.8 of the Transmission Owners Tariff for this new facility.

Should you have any questions or need anything additional, please do not hesitate to contact me immediately at (760) 323-9490 extension 122.

Very truly yours,

Jeffrey S. Welton
Vice President

Enclosures

125 E. Tahquitz Canyon Way, Suite 201, Palm Springs, CA 92262
(760) 323-9490 / Fax (760) 323-0688 / www.wintecenergy.com

APPLICATION FOR SERVICE UNDER TRANSMISSION OWNERS TARIFF

WINTEC REQUEST VIII
(Devers-Garnet 115kV Transmission Line)

This is an application request pursuant to the Transmission Owners Tariff to interconnect a 45MW gas-fired simple cycle electricity generating facility through a Southern California Edison Company ("SCE") 115kV Interconnect Facility that will be built on the Project parcel and deeded to SCE through a grant of easement. SCE will need to build a line extension from their Interconnect Facility on the Project parcel West along 19th Avenue to a 115kV tap that will need to be established on the Cal ISO controlled Devers-Garnet 115kV transmission line.

PRODUCER INTERCONNECTION INFORMATION

1. GENERAL INFORMATION

A. Project Name: **CORAL EAST**

B. Project Owner:

Wintec Energy, Ltd.
125 East Tahquitz Canyon Way, Suite 201
Palm Springs, California 92262
Telephone: (760) 323-9490
Fax: (760) 323-0688

C. Contact Person:

Frederick W. Noble / Jeffrey S. Welton
Wintec Energy, Ltd.
125 East Tahquitz Canyon Way, Suite 201
Palm Springs, California 92262
Telephone: (760) 323-9490
Fax: (760) 323-0688

2. SITE DATA

A. Project Location

i) West of N. Indian Avenue & South of 18th Avenue adjacent to 19TH Avenue North Palm Springs, Riverside County, California

ii) Location Map: **See enclosed USGS map and aerial photo.**

iii) Land Requirements: **3 Acres – Approx. 290 feet X 260 feet**

iv) Proof of site Control: **See attached Grant Deed**

B. Existing facility data

i) NOT APPLICABLE

ii) NOT APPLICABLE

iii) NOT APPLICABLE

iv) NOT APPLICABLE

3. PROJECT DATA

A. Project Type: **45MW gas-fired simple cycle electricity generating facility**

B. Generation Detail

i) Type of Generator: **LM6000 Enhanced Sprint combustion turbine generator – Synchronous**

ii) Manufacturer: **General Electric**

iii) Number of Units: **1**

iv) Capacity size of each generator: **45MW (see attached data)**

v) Kilovolt-ampere rating: **See attached Data Sheets**

vi) Net Capacity (kW) available for delivery to SCE: **See attached Data Sheets**

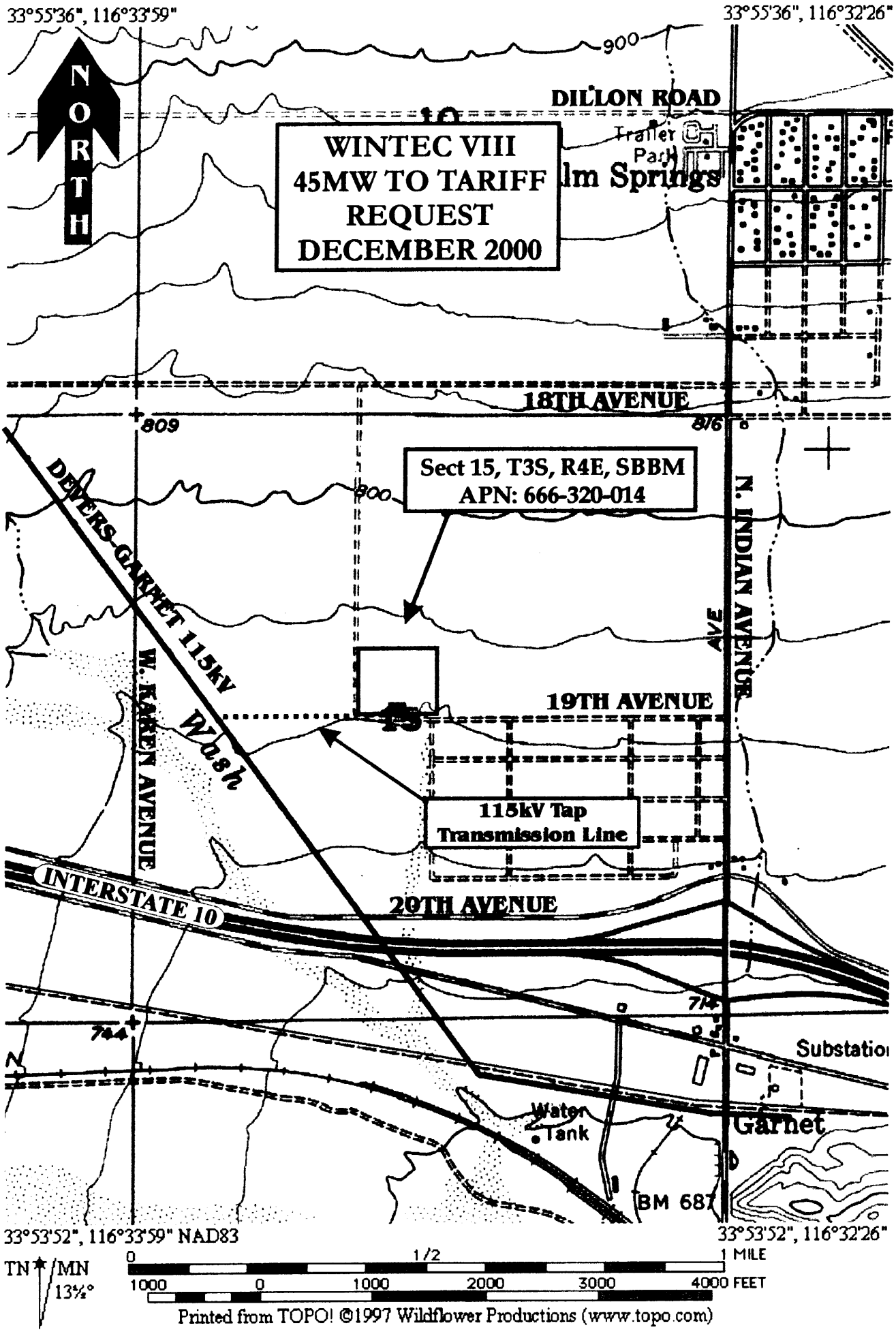
vii) Generator voltage rating: **See attached Data Sheets**

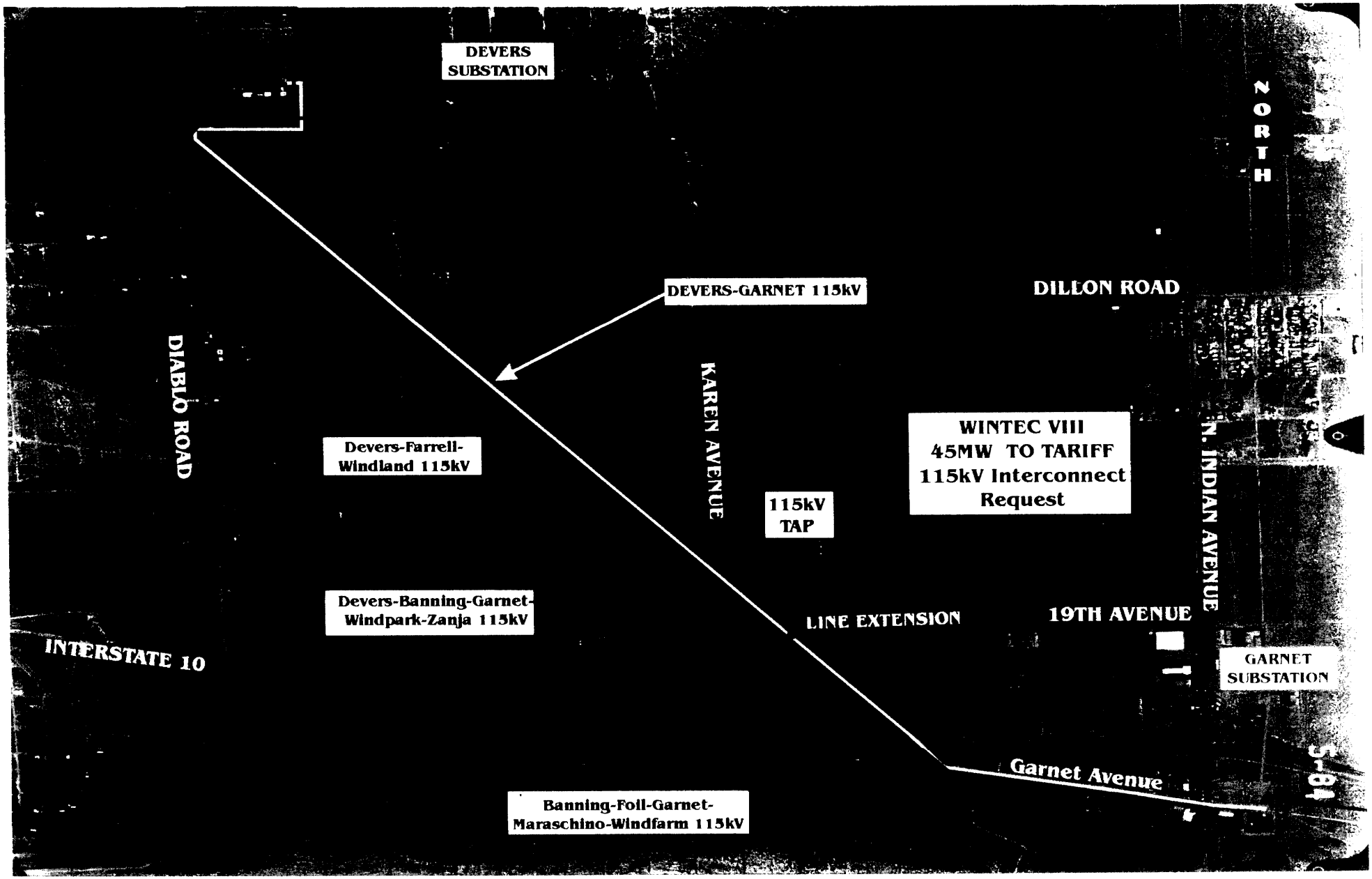
viii) Ampere rating: **See attached Data Sheets**

ix) Number of Phases: **See attached Data Sheets**

x) Frequency: **See attached Data Sheets**

xi) Power Factor: **See attached Data Sheets**




DEVERS SUBSTATION
NORTH
DEVERS-GARNET 115kV
DILLON ROAD
DIABLO ROAD
KAREN AVENUE
WINTEC VIII
45MW TO TARIFF
115kV Interconnect
Request
Devers-Farrell-
Windland 115kV
115kV
TAP
N. INDIAN AVENUE
Devers-Banning-Garnet-
Windpark-Zanja 115kV
LINE EXTENSION
19TH AVENUE
INTERSTATE 10
GARNET SUBSTATION
Garnet Avenue
Banning-Foil-Garnet-
Maraschino-Windfarm 115kV

RECORDING REQUESTED BY:
First American Title Company
AND WHEN RECORDED MAIL THIS DEED AND,
UNLESS OTHERWISE SHOWN BELOW,
MAIL TAX STATEMENTS TO:

Wintec Energy, LTD.
Frederick W. Noble
P.O. Box 457
N. Palm Springs, CA 92258

NO COR FILED

067250

RECEIVED FOR RECORD
AT 2:00 P.M.

Received
3-10-99

FEB 19 1999

Recorded in Official Records
of Riverside County, California
Recorder

Fees $ 6

SPACE ABOVE THIS LINE FOR RECORDER'S USE

6

Grant Deed

A.P.N. 666-320-014 8
TRA 011-087

The undersigned grantor(s) declare(s):
Documentary transfer tax is $ -0-
( ) computed on full value of property conveyed, or
( ) computed on full value less value of liens and encumbrances remaining at time of sale.
( ) Unincorporated area: ( ) City of _____, and

T
LS

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged,

RAY R. COULTER, a professional corporation, A California Corporation

hereby GRANT(S) to

WINTEC ENERGY, LTD., a California Corporation

the real property in the City of , County of **Riverside**
State of California, described as

The Southwest one quarter of the Southwest one quarter of the Northeast one quarter of Section 15, Township 3 South, Range 4 East, San Bernardino Base and Meridian, as shown by United States Government Survey.

2 13 5 23-21

Dated **February 18, 1999**

State of California)
) S.S.
County of **Riverside**)

On **February 18, 1999** before me,
Kelly Collier, personally
appeared
Ray R. Coulter, personally known to me (or proved to me on the basis of satisfactory evidence) to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

Signature **Ray R. Coulter, a professional corporatio**
Signature of Grantor

By: Ray R. Coulter
Ray R. Coulter, President

KELLY COLLIER
Comm. # 1057217
NOTARY PUBLIC CALIFORNIA
Riverside County
My Comm. Expires May 28, 1999

MAIL TAX STATEMENTS TO, **SAME AS ABOVE**

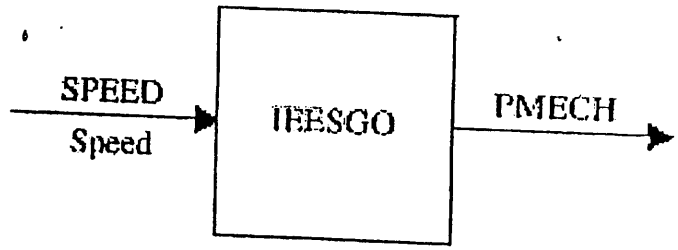
Form 3195-4 (6-94)

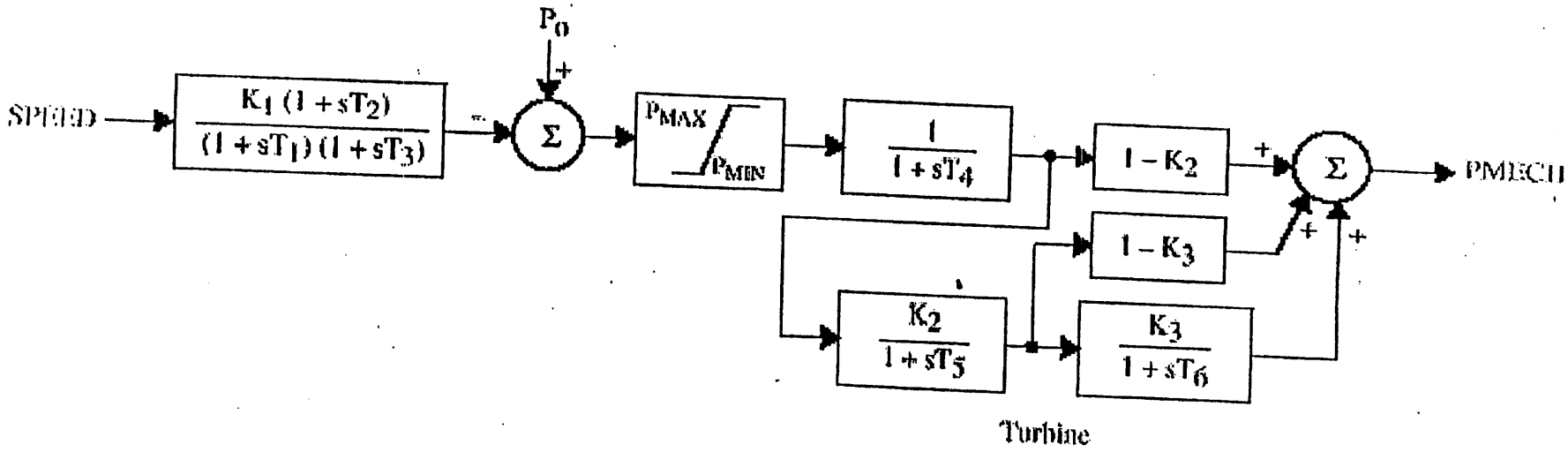
THIS FORM FURNISHED BY COMMONWEALTH LAND TITLE COMPANY

IEESGO

IEEE Standard Governor

This model is located at system bus #_____ IBUS,
machine #_____ I.
This model uses CONs starting with #_____ J,
and STATEs starting with #_____ K,
and VAR #_____ L.





Transfer function for the LM6000PC at max power for a 24 degF day, fixed IGV, gas fuel, 5% droop, with 4/10 in H2O inlet and exhaust losses respectively:

delta torque/delta LP rotor speed = $\frac{-540.37}{(7.89s+1)}$ $\frac{[LBF\text{-}FT]}{[RPM]}$

delta horsepower/delta LP rotor speed = $\frac{-352.63}{(7.89s+1)}$ $\frac{[SHP]}{[RPM]}$

It should be remembered that this is a linear model only valid at the above conditions for small perturbations about the operating point. It provides an estimate of the transient behavior ***but it does not provide performance guarantees.***

CONs	#	Value	Description
J		7.89	T_1, controller lag (sec)
J+1		0.01	T_2, controller lead compensation (sec)
J+2		0.01	T_3, governor lag (>0) (sec)
J+3		0.01	T_4, delay due to steam inlet volumes associated with steam chest and inlet piping (sec)
J+4		0.01	T_5, reheater delay including hot and cold leads (sec)
J+5		0.01	T_6, delay due to IP-LP turbine, crossover pipes, and LP end hoods (sec)
J+6		20.216	K_1, 1/per unit regulation
J+7		0.0	K_2, fraction
J+8		0.0	K_3, fraction
J+9		1.2	P_{MAX}, upper power limit
J+10		0.8	P_{MIN}, lower power limit

STATEs	#	Description
K		Filter output
K+1		Valve or gate servo output
K+2		Turbine powers
K+3		Turbine powers
K+4		Turbine powers

VAR	#	Description
L		Reference, P_0

ASSUMPTIONS

1. **Values for constants are set to duplicate LM6000 PC transfer function as specified on sheet 2.. Constants do not match the Descriptions as specified in table.**
2. **SPEED is LP rotor deviation from nominal in rpm/3600**
3. **Pmech is delivered power in horsepower/62794.6**

IBUS, 'IEESGO', I, T_1, T_2, T_3, T_4, T_5, T_6, K_1, K_2, K_3, P_{MAX}, P_{MIN}/

WOODWARD
Industrial Controls

Customer: GE S&S Energy Products
Subject: LM6000 PC Core Fuel Control Description

Date: May 28, 1999
Revision:

LM6000 PC CONTROL SYSTEM OVERVIEW

The LM6000 PC gas turbine, manufactured by GE, utilizes a single annular combustor design.

Implementation of GE Control Specification

The Core Fuel Control application software was developed in such a way that whenever possible, the GE control specification was implemented directly as defined by GE. Similar terminology was used where applicable to ease the translation from the GE control specification to Woodward supplied application software. In all cases where direct input of GE specification could not be done, GE was informed and functionality of logic verified as a part of the control system qualification.

Control System Overview

In defining the control application software it was determined to separate the control system into three distinct areas, which are the: Core Fuel Control, Fuel Metering System and Sequencing/Package specific. Although components of all of these main items are contained in the "core", the majority of the logic is made up of the Core Fuel Control and the Fuel Metering System.

The only Sequencing/Package specific logic contained in the "core" are the minimum interface variables required to merge the "core" application with the "2nd Ring" application software. The Core Fuel Control contains five unique components which define the makeup of the application. These components are, input signal processing (ISP), output signal processing (OSP), control laws (C_LAW), data monitoring/acquisition (DATA_IO) and fault accommodation. Below is a summary of the main control functions carried out in the Core Fuel Control.

Fuel Control

The fuel control contains the necessary logic to define the fuel flow control and turbine operating limits based on the requirements defined in the control specification. Non-GE specified logic is also implemented to achieve data acquisition/monitoring functions and allow user configuration on non-critical control features (for both Core Fuel Control and Fuel Metering System).

Listed below are the primary control system regulators (control loops) and limits which are performed by the Core Fuel Control:

Table 1.0 Core Regulators

REGULATOR (INTEGER EQUIVALENT)	CONTROL MODE DESCRIPTION	REGULATOR TYPE (PID, OPEN LOOP)
LP Rotor Speed Control (REGULATOR = 1)	Provides speed control based on an external speed demand into the Core Fuel Control. Internal core limits are placed on the speed demand to prevent operation outside of specified limits. The Control Process, N2ROTOR is configured to be N2 or NSD. Control Process: N2ROTOR Control Reference: NSDDMD	PID w/scheduled dynamics.
HP Rotor Speed Control (REGULATOR = 2)	Provides speed control based on an external speed demand into the Core Fuel Control. Internal core limits are placed on the speed demand to prevent operation outside of specified limits and based on the ambient temperature condition (corrected gas HP speed limit). Control Process: N25SEL Control Reference: N25REF	PID w/scheduled dynamics.
HP Rotor Speed Deceleration Limit (REGULATOR = 3)	Provides control of gas generator speed deceleration based on core derived dN/dt schedules. Control Process: N25DOT Control Reference: N25DEC	PID w/fixed dynamics
HP Rotor Speed Acceleration Limit (REGULATOR = 4)	Provides control of gas generator speed acceleration based on core derived dN/dt schedules. Control Process: N25DOT Control Reference: N25ACC	PID w/fixed dynamics
Minimum Fuel Flow Limit - WFLBO (REGULATOR = 5)	Provides fixed minimum fuel flow limit.	OPEN LOOP fuel flow limit into fuel metering system.
HP Turbine Inlet Temperature Limit (REGULATOR = 6)	Provides temperature topping control for the power turbine inlet temperature (T48) based on core derived setpoint. Control Process: T48EST Control Reference: T48REF	PID w/fixed dynamics
HP Compressor Discharge Pressure Limit (REGULATOR = 7)	Provides topping control for the HP compressor discharge pressure (PS3) based on core derived setpoint. Control Process: PS3SEL Control Reference: PS3REF	PID w/fixed dynamics
HP Compressor Discharge Temperature Limit (REGULATOR = 8)	Provides topping control for the HP compressor discharge temperature (T3) based on core derived setpoint. Control Process: T3EST Control Reference: T3REF	PID w/fixed dynamics
HP Rotor Speed Limit (REGULATOR = 9)	Provides T2 corrected topping limit for gas generator speed (N25). Control Process: N25SEL Control Reference: N25HREF	PID w/scheduled dynamics

REGULATOR (INTEGER EQUIVALENT)	CONTROL MODE DESCRIPTION	REGULATOR TYPE (PID, OPEN LOOP)
Maximum Fuel Flow Limit - WFMAX (REGULATOR = 10)	Provides maximum fuel flow limit based on: 1. Start fuel flow. 2. Wf / PS3 topping fuel flow limit (stall margin protection). 3. Fail-safe topping fuel limit for radial drive shaft failure protection.	OPEN LOOP fuel flow limit into fuel metering system.

Airflow Control

The airflow control operates in conjunction with the fuel control to maximize efficiency and performance over all operating ranges. Listed below are the active control loops used to regulate the airflow to the gas turbine:

Turbine Airflow Control

Variable Inlet Guide Vane - Scheduled airflow control.

Variable Bleed Valve - Scheduled bleed valve control.

Variable Stator Vane - Scheduled airflow control.

Fuel Metering System

This section contains the necessary logic to interface between the GE defined core fuel control logic and the Woodward defined fuel system. Although integrated into the core fuel control logic, the fuel system logic has been intentionally segregated to allow separation between items which GE defines and requirements which are Woodward scope of supply. The Fuel System, much like the Core Fuel Control also contains input signal processing (ISP), output signal processing (OSP), data monitoring/acquisition (DATA_IO) and fault accommodation but it is integrated into the Core Fuel Control.

Start/Stop Sequencing Implementation

The start/stop sequencing is not included in the scope of the LM6000 PC Core Fuel Control but can be included in an integrated control system supplied by Woodward or via an external non-Woodward supplied sequencer. The core fuel control does interface with the start/stop sequencing logic on a limited basis to determine key sequence states (i.e. ignition on, fuel on, etc...).

Specific gas turbine sequencing requirements defined by GE in the control specification and/or the installation design manual should be reviewed when defining start stop sequencing functionality.

Data Acquisition/Monitoring Capabilities

The basic options available for data acquisition and monitoring include a standard MODBUS configuration for use with pre-programmed HMI (or similar device), DATALOG capabilities for capturing transient data files with a pre-defined list of variables determined by Woodward Governor and GE, and use of the remote service panel which allows an expanded view of internal NetCon® parameters from a serial link to a PC. Below is a listing of the standard data interfaces available in the NetCon®:

- HMI Data Acquisition/Monitoring System.
- NetCon® High-Speed Data Capture (DATALOG).
- NetCon® Service Panel - PC Based Service Panel Emulator (SRVPNL).
- Modbus (UDP, RTU, ASCII).
- Control Assistant (TUNER) - Tunable Upload/Download/Maintenance, Datalog Upload/Download/Plotting, Executable Code Upload/Download.

LM6000 PC CORE FUEL CONTROL COMPONENTS

The components which make up the LM6000 PC control system are based upon the requirements defined in the GE LM6000 PC Control Specification M50TF3806.

The Woodward Governor Company control system offering for the LM6000 PC has been designed so that the application software can be used for a variety of engine applications with customer options for control features which are not critical to engine performance and operation. The control system may perform all of the engine and installation specific control functions including non-engine related auxiliaries, or as little as the core fuel control relying on external customer sequencing and auxiliary control.

Hardware

The hardware selected to perform the LM6000 PC control and fuel system functions is comprised of standard NetCon® and accessory modules/drivers which have been through extensive Design Assurance Testing at component and system integration levels. Certain hardware functions supported by the Core Fuel Control not selected by the system supplier as an option, may be excluded from the LM6000 PC control system hardware platform.

An example is off-loading the monitoring off non-critical engine functions to a separate hardware platform (i.e. PLC, plant control DCS). Although the software is still embedded in the Core Fuel Control software, the function are not selected as options

(see configuration options) and the qualification of the functionality with GE is the responsibility of the system supplier.

Software

The primary components which make up the entire LM6000 PC control system application software are as follows: core fuel control, fuel system, start/stop sequencing and installation specific. These components are linked together to complete the system application software, but by distinguishing unique control functions, modifications can be made to installation specific software with little to no affect on the remaining components. The Core Fuel Control is a single component of the overall control system.

Review of Software Development Process

The software development process for LM6000 PC Core Fuel Control application software is based on the requirements of the GE LM6000 PC Control Specification M50TF3806. The development and testing of the Core Fuel Control is done in conjunction with the control system qualification required by GE for the LM6000 PC. All of the functionality contained in the Core Fuel Control is covered by the qualification process, but if core options are not selected, it is the responsibility of the system supplier to ensure the functional implementation meets the engine manufacturer's requirements (i.e. the control specification).

The fuel system specific application software was developed to meet the requirements set forth in Appendix C of GE LM6000 PC Control Specification M50TF3806.

Software Test/Verification Tools

The methods for verification of the various components of the Core Fuel Control can be done using several means of testing as listed below. The primary method of testing the Core Fuel Control functionality is via the LM Engine Simulator per requirements defined by GE qualification process.

- LM Engine Simulator - Allows testing of the Core Fuel Control integrated to a pre-defined hardware configuration against a real-time engine simulator supported by a GE real time engine model (implemented on a NetCon® hardware platform).
- Software Simulation - Allows testing of the Core Fuel Control on a software based simulation platform against the GE supplied real time engine model. This option also provides a method for integrating a complex turbine model into a

larger system level test for verification of sequencing and auxiliary control system functions without requiring a full hardware model of the turbine to be developed.

- Test Vectors - Allows software testing of individual control functions/modules. This test method is employed extensively in the development stages of the Core Fuel Control applications for all LM gas turbines.
- WGC Flow Facility - Allows active flow testing of fuel system components under expected operating conditions. The flow facility is utilized in the flow verification of all fuel metering valves.

Implementation of Control Specification Requirements

Below are the methods employed for implementation of the various forms of control system requirements contained in GE LM6000 PC Control Specification M50TF3806.

Logic Diagrams

The logic diagrams/requirements contained in the GE LM6000 PC Control Specification M50TF3806, were implemented as closely to the design intent as compatibility would allow. Where explicit control functions could not be exactly duplicated, software was generated to meet the functional intent while attempting to maintain a reasonable resemblance to the requirements. In certain cases were Woodward Governor Company had existing software features that allowed the requirements to be streamlined, this was done if functional requirements were meet.

GE Datatables

The numerous datatables supplied by GE are directly linked to control system via an electronic ASCII file supplied by GE. With each revision of the GE LM6000 PC Control Specification M50TF3806, new datatables are supplied, which are then tested after the control system application software has been modified to meet the revised requirements. No manual manipulation of the GE provided datatables occurs, the conversion of the tables is done through a software utility which converts the datatables to a format compatible to the control system.

Adjustable Parameters

The adjustable parameters defined/specified by GE are implemented directly per the requirements in the LM6000 PC Control Specification M50TF3806. A Woodward supplied software utility (Control Assistant) is available to ease the maintenance of site

specific adjustments. The Control Assistant application runs on any PC system with Windows 95 and supports serial or Ethernet communications interfaces.

A standard core adjustment list will be supplied with each revision of the Core Fuel Control software that will include the baseline settings of the adjustable parameters defined in the GE LM6000 PC Control Specification M50TF3806.

Fault Accommodation

The fault accommodation logic is implemented as defined in the GE LM6000 PC Control Specification M50TF3806, but is separated into sections which represent the Core Fuel Control and integrated the Fuel Metering System control functions. Each individual fault condition is done in the respective section of the application software which relates to the fault condition (i.e. N25 failed detection is done in the I_N25 module).

LM6000 PC CORE DESCRIPTION DOCUMENT

The Core Fuel Control and associated logic are utilized in the NetCon® Control System to control the GE LM6000 PC Gas Turbine. The basic control techniques employed are defined in the next section. For specific implementation details, the GAP™ diagrams should be consulted. The Core Fuel Control utilizes the multiple GAP™ design structure and is not capable of generating executable code without an interface to a Master GAP™ application.

The core must be called from a Master GAP™ application, which handles the control system hardware configuration, and to varying degrees, the sequencing and site/customer specific control functions. This core is generated per the specific control requirements of the GE LM6000 PC Control Specification M50TF3806, but has provisions to include certain customer specific requirements such as instrumentation deviations and flexibility to adapt to various hardware configurations.

The LM6000 PC Gas Turbine Core Fuel Control (P/N 5413-962) supports multiple engine configurations based on the GE LM6000 PC Control Specification M50TF3806. To familiarize Core Fuel Control users with some of the basic nomenclature associated with the LM6000 PC offering, a subset of variables is listed in Table 2.0.

Appendix A1 and A2 define many of the primary analog and digital control system variables respectively. The variable lists include I/O signals, control parameters, control status, and general turbine data. The analog list includes the control variable name, the nominal operating range, unit of measure, and a brief

description. The digital list includes the control variable name, the active TRUE state, and a brief description.

Table 2.0 System Nomenclature

Variable	Description
N2	LP rotor speed measured at the LP compressor stage 0.
NSD	LP rotor speed measured at the LP turbine.
N25	HP rotor, core, or gas generator speed measured on the accessory gearbox.
N25R	HP rotor speed corrected to T2.
T2	LP Compressor inlet temperature.
T25	HP Compressor inlet temperature.
T3	HP compressor discharge temperature.
T48	LP/Power turbine inlet temperature.
TGS	Gas fuel supply temperature @ fuel metering valve inlet.
TLQ	Liquid fuel supply temperature @ fuel metering valve inlet.
P2	Inlet pressure.
P25	LP Compressor inlet pressure.
PS3	HP compressor discharge static pressure.
P48	LP/Power turbine inlet pressure.
PGS	Facility gas supply pressure.
PLQ	Facility liquid supply pressure.
DPS3DT	HP compressor discharge static pressure rate of change (derivative).
N25DOT	HP rotor speed rate of change (derivative).
WF36DMD	Gas turbine fuel flow demand.
IGV	Variable Inlet Guide Vane.
VBV	Variable Bleed Valve.
VSV	Variable Stator Vane.
TBV	Thrust Balance Valve.
WF	Weighted fuel flow (WF36DMD, WFPLTDMDGS, WFPLTDMDLQ).
GMV	Gas fuel metering valve.
LMV	Liquid fuel metering valve.
NET	NetCon® base I/O module.
L/N	NetCon® LinkNet® I/O module.

Description of Core Functions

Configuration Options

The GE LM6000 PC core fuel control supports the following turbine/control configuration settings and options. Detailed information is available in Appendix B (configuration options) and Appendix D3 for the detailed Core Fuel Control interface parameters.. The primary configuration options that the Core Fuel Control supports

relate to non-engine critical I/O functions (lube monitoring, thrust monitoring, sensor options, etc) or engine application specific options (power/mech drive, etc).

Instrumentation

The core fuel control supports the majority of the engine related instrumentation as either required inputs or as options selected per the configuration options. All core I/O options not selected should be reviewed jointly by GE and the system supplier.

For all instrumentation inputs, the Core Fuel Control input signal processing logic (ISP) generates a validated process variable to be used by the Core Fuel Control algorithms. The ISP logic also monitors hardware status inputs (i.e. failed sensor flag) and performs any additional fault detection logic required to meet the fault accommodation requirements in the control specification.

Required/optional instrumentation for the GE LM6000 PC gas turbine includes the variables defined in Appendix C. The hardware functionality and I/O type define the control system options available for certain devices.

Interface

The Core Fuel Control utilizes four (4) interface blocks to connect to the upper level "2nd Ring" or "Master" GAP™ application. These include the IFACE_HDWR category, IFACE_CORE category, IFACE_CNFG category, and the IFACE_COMM category. The contents of each of these categories is briefly described below and documented in detail in Appendix D1-D5 (also available in spreadsheet format upon request).

- The IFACE_HDWR category provides for the connection to all instrumentation input signals and hardware related faults. Hardware faults must indicate NetCon® hardware related faults, failed sensor (i.e., high ma, low ma, open circuit), communication link fault, etc. The core signal processing handles all process variable range checking and associated alarm generation.
- The IFACE_CORE category provides for the connection to "dynamic" control inputs from the "2nd Ring" application. This includes sequencing related inputs, reference values for gas generator speed and power turbine speed, control reset, alarm acknowledge, etc.
- The IFACE_CNFG category allows the user to configure the core from the "2nd Ring" application. This core provides for various instrumentation configurations and gas turbine configurations/options. The intent of the core is to accommodate all configurations for the GE LM6000 PC gas turbine.

- The IFACE_COMM category provides an interface to configure the resident core datalog, modbus (serial or ethernet communications available), and GE specified remote monitoring communication (RS422) port definitions.

Fault Accommodation Report (Core and Fuel System)

The Core Fuel Control accommodates the fault accommodation logic associated with the GE LM6000 PC Control Specification M50TF3806 and the parallel (three valve) Fuel Metering System. The fault accommodation logic is segregated into distinct categories that correlate to the engine manufacturers requirements.

The fault accommodation categories are: alarms (Z_ALARM), decel to minimum load/speed (Z_DECELMIN), step to gas generator idle (Z_STEPIDLE), compressor stall detection (Z_STALLDET), and emergency motored or non-motored shutdowns (Z_SHUTDOWN). These main categories are then broken down into two sub-sets per category to separate the GE specified fuel control/engine related faults (CORE) and the fuel metering system specific faults (FMS).

Each fault accommodation category has an associated control action (Core Fuel Control specific) associated when a fault condition occurs.

- ALARM - The alarm condition control action is annunciation only on an individual fault condition and summary indication level.
- DECELMIN - The control action for a decel to minimum load/speed condition is annunciation only on an individual fault condition and an overall summary indication. The "2nd Ring" application must be configured to bring the unit to a minimum load/speed condition. The fault condition cannot be reset until the unit has achieved a minimum load/speed operating point (criteria differs for power generation and mechanical drive applications).
- STEPIDLE - The control action for a step to gas generator idle fault condition provides annunciation on an individual fault condition and an overall summary indication. The Core Fuel Control also sets the gas generator speed setpoint to the idle setting (bypasses external speed demand). The fault condition cannot be reset until the unit has achieved gas generator idle and the external gas generator speed reference is brought to idle setpoint.
- SHUTDOWN - The control action for a shutdown condition is annunciation on an individual fault condition and an overall summary indication. The Core Fuel Control will set the fuel control demand(s) to a "fuel-off" condition, and set or schedule all required outputs (variable geometry, modulated bleed valves) to the shutdown or fuel-off state. The "2nd Ring" application is responsible for monitoring the Core Fuel Control shutdown status indications and take the

appropriate system response (i.e. close fuel shutoff valves, initiate post shutdown sequences, etc...).

Appendix E provides a detailed listing of the fault conditions monitored by the Core Fuel Control and the Fuel Metering System fault conditions.

LM6000 PC FUEL SYSTEMS

Fuel System Options

When purchasing a fuel system from Woodward Governor Company, the system supplier has the option of purchasing individual components or a complete fuel skid. If the system supplier purchases individual components, the requirements set forth in Appendix C of the GE LM6000 PC Control Specification M50TF3806 should act as the guideline for fuel system installation.

Upon request from the system supplier, complete DESIGN ASSURANCE TESTING test results or the required production fuel system test results as defined in Appendix C of the GE LM6000 PC Control Specification M50TF3806 will be made available.

LM6000 PC SIMULATION TEST PLAN

Standard Engine Run Testing

The following standard test cases will be made available for qualification of the core fuel control portion of new control systems to match the version of the current control specification and per the engine application of the system supplier (i.e. mechanical drive, power generation, with or without IGV's). Electronic files (datalog) will be made available to GE.

Ambient Conditions

Gas supply pressure	650 PSI	
Gas LHV	19000 BTU/lbm	
Gas SG	.566	
Gas Temperature	59 Deg F	
Temperature (T2)	Std. Day	59 Deg F
	Cold Day	-10 Deg F

	Hot Day 110 Deg F
Pressure (P0)	14.7 PSIA

Test Cases (Power Generation, with and without IGV's, Gas Fuel)

Start to Core Idle	- standard, hot and cold ambient conditions.
Core Idle to Synch Idle	- standard day, 1 minute accel rate.
Synch Idle to Full Power	- standard day, 3 minute accel rate.
Full Power to Synch Idle	- 3 minute decel rate.
Synch Idle to Core Idle	- 1 minute decel rate.
Decel to Min	- decel from full power.
Step to Idle	- step to gas generator idle from full power.
Emergency Shutdown	- emergency shutdown from full power.

Test Cases (Load Trancients, Power Generation, without IGV's, Gas Fuel)

0-25% Load Accept

0-50% Load Accept

50-75% Load Accept

75-100% Load Accept

100-0% Load Reject

50-0% Load Reject

75-0% Load Reject

50-0% Load Reject

Fault Accommodation Testing

The fault accommodation testing shall be performed on all shutdown, step-idle, decel-min and alarm conditions using the mechanical drive engine application as the test platform. Derivative testing for engine application specific faults will be done as required on the specific engine application which the fault is related to.

For qualification purposes, the core fuel control and fuel system related faults shall be verified on the Woodward Governor Company LM6000 PC engine simulator.

Site specific fault testing will be accommodated through other means, whether at the site or some other form of simulation.

A detailed listing of all fault conditions monitored by the NetCon® control system is included in the manual. Verification shall be made of each condition and submitted to the system supplier in a format agreed to by the system supplier and control supplier

Frequency Response Testing

Fast Fourier Transform (FFT) measurements of variable geometry's control loop frequency response were conducted and verified by GE. Each individual control loop (VBV, IGV, VSV, and TBV) was tested using the Matlab-Siglab® network analazer to generate magnitude and phase data for the actuator LVDT position to torque motor output. This data was confirmed to meet the requirements set for in the GE LM6000 PC Control Specification M50TF3806 section 3.5.9 (Variavle Geometry Dynamic Response Requirements). For a detailed explaination of the testing performed see Appendix F.

Start/Stop Sequencing

All simulator qualification testing of the Woodward Governor Company core fuel control application shall use generic start/stop sequencing that is not installation specific. If the system supplier chooses to use a non Woodward Governor Company provided sequencing, the system supplier will have to meet GE qualification requirements through other means agreed to by the system supplier and GE.

LM6000 PC ENGINE PROTECTION SYSTEMS

Redundant Overspeed Protection

Depending on the scope of supply for Woodward Governor Company, the redundant overspeed devices may or may not be supplied by Woodward Governor Company. For systems where Woodward Governor Company does supply the redundant overspeed protection, the electronic device(s) have been selected to respond in 20 msec or less, with the average response time of the fuel shutoff valves to be approximately 100 msec. The trip circuits are routed in parallel, one directly to the fuel shutoff valve critical path and the other to the control system emergency shutdown logic.

It is important to note that each system must be evaluated for fuel shutoff timing compliance based on system hardware and techniques used. Detailed information on

the devices used and configuration are available upon request from the system supplier.

Fuel Shutoff Solenoid Monitoring

On fuel systems where Woodward Governor Company supplies the fuel shutoff valves, an option is given to the system supplier to include position (proximity) switches which are used to monitor the demanded vs. actual fuel shutoff valve position.

On fuel systems without positive position feedback, whether supplied by Woodward Governor Company or not, the option is available to provide fuel shutoff valve solenoid monitoring via current detection in the solenoid loop.

Both of the options mentioned above are implemented only at the system suppliers request. Any qualification shortcomings due to the lack of fuel shutoff solenoid monitoring shall be addressed by GE and the system supplier.

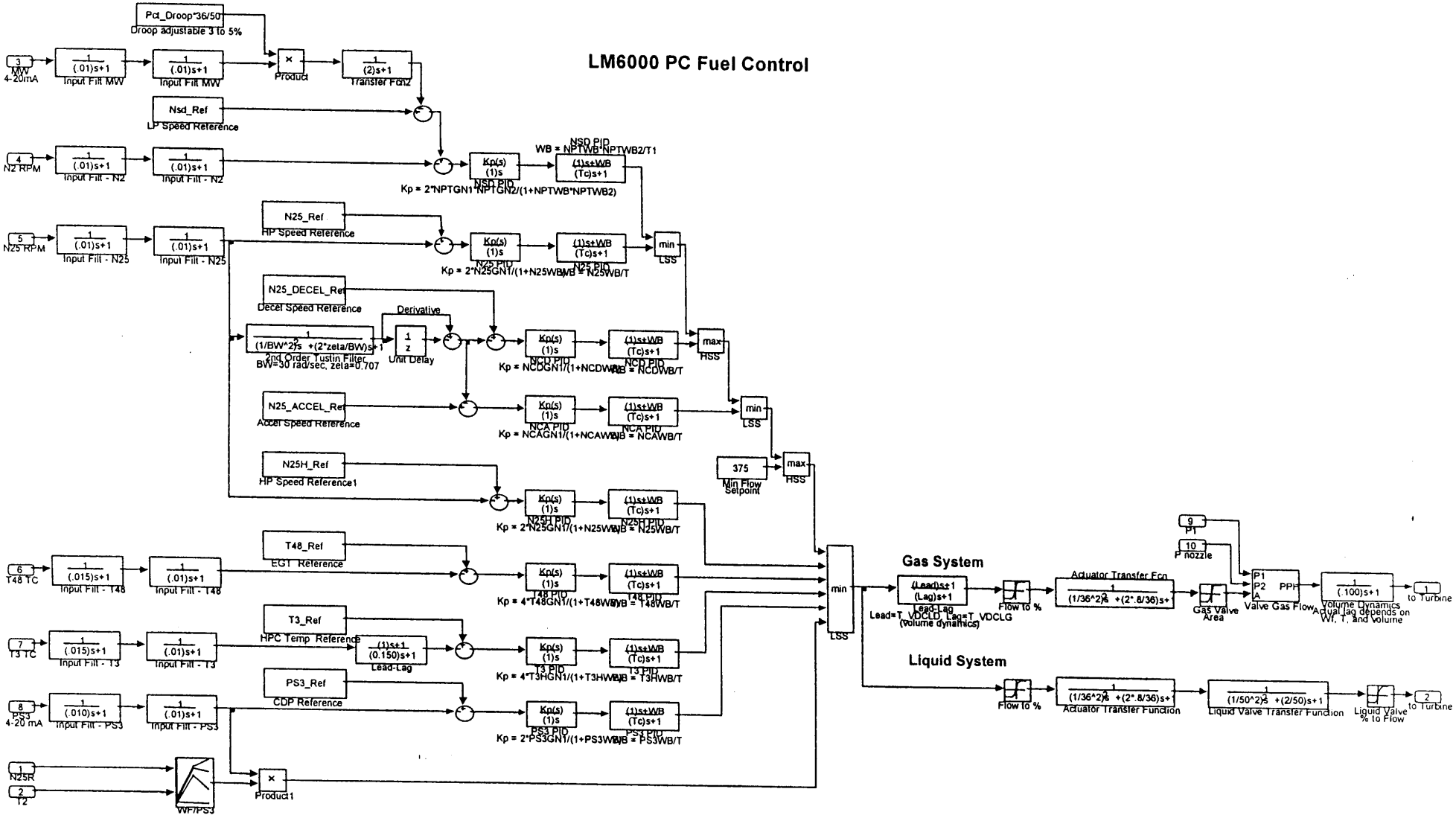
Stall Detection

Woodward Governor has implemented a combination of hardware and software techniques developed specifically for the purpose of stall detection on the LM6000PC. This scheme has been implemented as the standard on control systems for the LM6000PC and other LM engine lines as well.

WOODWARD
Industrial Controls

Customer: GE S&S Energy Products
Subject: LM6000 PC Core Fuel Control Function Block Diagram

Date: May 28, 1999
Revision:



WOODWARD
Industrial Controls

Customer: GE S&S Energy Products
Subject: LM6000 PC Core Fuel Control Dynamic Settings

Date: May 28, 1999
Revision:

LM6000 PC REGULATOR INFORMATION

LP ROTOR SPEED CONTROL - NSD REGULATOR

- NPTGN1 =
  X = PS3EST (PSIA)
  Y = NSDGN1

132.00000	14.47000
132.30000	14.47000
169.20000	14.47000
197.10000	15.91700
254.40000	18.81100
305.70000	11.58000
365.20000	13.75000
429.50000	15.92000
430.00000	15.92000

- NPTGN2 = 1
- NPTWB =
  X = PS3EST (PSIA)
  Y = NSDWB1

132.00000	0.002000000
132.30000	0.002000000
169.20000	0.002000000
197.10000	0.002400000
254.40000	0.003000000
305.70000	0.003000000
365.20000	0.003000000
429.50000	0.003400000
430.00000	0.003400000

- NPTWB2 =

X = NSDERR
Y = NPTWB2

-1.00000	1.00000
0.00000	1.00000
25.00000	3.00000
26.00000	3.00000

- T = 0.02
- Tc = T/1+NPTWB

HP ROTOR SPEED CONTROL - N25 REGULATOR

- N25GN1 =
  X = PS3EST (PSIA)
  Y = NSDGN1

53.00000	2.31520
53.30000	2.31520
70.00000	2.60460
90.00000	2.89400
132.30000	2.89400
169.20000	3.61750
197.10000	3.61750
254.40000	4.19630
305.70000	4.26870
365.20000	4.34100
429.50000	5.06450
430.00000	5.06450

- N25WB =
  X = PS3EST (PSIA)
  Y = N25WB

53.00000	0.005000000